

CLAIMS:

1. A system for measuring magnetic fields using a superconducting quantum interface device, wherein the system comprises:

an unmodulated flux locked loop operable to achieve a substantially stable
operating point at the superconducting quantum interface device; and
a coaxial transmission line adapted to electrically connect the unmodulated flux
locked loop and the superconducting quantum interface device.

2. The system as set forth in claim 1, wherein the unmodulated flux locked
loop is located in a non-cryogenic environment, and the coaxial transmission line is
adapted to extend between the non-cryogenic environment and the superconducting
interface device.

3. The system as set forth in claim 2, wherein the non-cryogenic environment
is a magnetically unshielded environment.

4. The system as set forth in claim 1, wherein the unmodulated flux locked
loop includes only linear, wide-band DC componentry.

5. The system as set forth in claim 1, wherein the unmodulated flux locked loop includes -

5 a controlled-impedance bias tee operable to send a bias current into the superconducting quantum interface device and to receive an output signal generated by the superconducting quantum interface device via the coaxial transmission line;

a low noise amplifier operable to amplify the output signal generated by the superconducting interface device;

10 a loop gain adjustment for optimizing performance of the unmodulated flux locked loop;

a first DC amplifier for amplifying an output of the low noise amplifier;

a first integrator network operable to facilitate achieving a stable phase locked feedback of the output signal generated by the superconducting quantum interface device;

15 a second DC amplifier for providing a wideband signal gain;

an offset adjustment device for adjusting a DC offset of an output of the first integrator network;

a second integrator network operating in conjunction with the first integrator network to provide performance of a two-pole integrator; and

20 an output amplifier for amplifying an output of the second integrator network.

6. The system as shown in claim 5, wherein the first and second integrator networks are each a passive lead-lag network.

25

30

7. A system for measuring magnetic fields, wherein the system comprises:
a superconducting quantum interface device operable to detect changes in
magnetic flux;

an unmodulated flux locked loop for achieving a substantially stable magnetic
flux operating point at the superconducting quantum interface device by
introducing a feedback magnetic flux that counteracts an externally
applied magnetic field;

a first unbalanced coaxial transmission line for carrying a feedback signal
corresponding to the externally applied magnetic field from the
unmodulated flux locked loop to the superconducting quantum interface
device; and

a second unbalanced coaxial transmission line both for carrying a bias current
from the unmodulated flux locked loop to the superconducting quantum
interface device and for carrying an output signal from the
superconducting quantum interface device to the unmodulated flux locked
loop.

8. The system as set forth in claim 7, wherein the superconducting quantum
interface device is located in a cryogenic environment, the unmodulated flux locked loop
is located in a non-cryogenic environment, and the first and second unbalanced coaxial
transmission lines extend between the cryogenic environment and the non-cryogenic
environment.

9. The system as set forth in claim 8, wherein the non-cryogenic environment
is a magnetically unshielded environment.

10. The system as set forth in claim 7, wherein the unmodulated flux locked
loop includes only linear, wide-band DC componentry.

11. The system as set forth in claim 7, wherein the unmodulated flux locked loop includes -

5 a controlled-impedance bias tee for sending the bias current into the superconducting quantum interface device and for receiving the output signal generated by the superconducting quantum interface device via the second unbalanced coaxial transmission line;

an impedance match for terminating the second unbalanced coaxial transmission line in a characteristic impedance of the second unbalanced coaxial transmission line;

10 a low noise amplifier for amplifying the output signal of the superconducting interface device;

a loop gain adjustment for optimizing performance of the unmodulated flux locked loop;

a first DC amplifier for amplifying an output of the low noise amplifier;

15 a first integrator network for facilitating achieving a stable phase locked feedback of the output signal of the superconducting quantum interface device;

a second DC amplifier for providing a wideband signal gain;

an offset adjustment for adjusting a DC offset of an output of the first integrator network;

20 a second integrator network operating in conjunction with the first integrator network to provide performance of a two-pole integrator;

an output amplifier for amplifying an output of the second integrator network; and

a matching combiner for matching a characteristic impedance of the first unbalanced coaxial transmission line.

25

12. The system as shown in claim 11, wherein the first and second integrator networks are each a passive lead-lag network.

30

13. The system as set forth in claim 7, wherein the first unbalanced coaxial transmission line is impedance matched at the unmodulated flux locked loop and is not impedance matched at the superconducting quantum interface device.

5 14. The system as set forth in claim 7, wherein the second unbalanced coaxial transmission line is impedance matched at the unmodulated flux locked loop and is not impedance matched at the superconducting quantum interface device.

10 15. The system as set forth in claim 7, wherein the first and second unbalanced coaxial transmission lines are impedance matched at both the unmodulated flux locked loop and the superconducting quantum interface device.

15

20

25

30

16. A system for measuring magnetic fields, wherein the system comprises:
a superconducting quantum interface device operable to detect changes in
magnetic flux;

an unmodulated flux locked loop for achieving a substantially stable magnetic
flux operating point at the superconducting quantum interface device by
introducing a feedback magnetic flux that counteracts an externally
applied magnetic field, wherein the unmodulated flux locked loop includes
only linear, wide-band DC componentry, and wherein the unmodulated
flux locked loop is located in a non-cryogenic and magnetically unshielded
environment;

a first unbalanced RF coaxial transmission line for carrying a feedback signal
corresponding to the externally applied magnetic field from the
unmodulated flux locked loop to the superconducting quantum interface
device; and

a second unbalanced RF coaxial transmission line both for carrying a bias
current from the unmodulated flux locked loop to the superconducting
quantum interface device and for carrying an output signal from the
superconducting quantum interface device to the unmodulated flux locked
loop.

17. The system as set forth in claim 16, wherein the superconducting quantum
interface is located in a substantially cryogenic environment, and the first and second
unbalanced RF coaxial transmission lines extend between the cryogenic environment
and the non-cryogenic environment.

18. The system as set forth in claim 16, wherein the unmodulated flux locked loop includes -

- 5 a controlled-impedance bias tee for sending the bias current into the superconducting quantum interface device and for receiving the output signal generated by the superconducting quantum interface device via the second unbalanced RF coaxial transmission line;
- an impedance match for terminating the second unbalanced RF coaxial transmission line in a characteristic impedance of the second unbalanced RF coaxial transmission line;
- 10 a low noise amplifier for amplifying the output signal of the superconducting interface device;
- a loop gain adjustment for optimizing performance of the unmodulated flux locked loop;
- a first DC amplifier for amplifying an output of the low noise amplifier;
- 15 a first integrator network for facilitating achieving a stable phase locked feedback of the output signal of the superconducting quantum interface device, wherein the first integrator network is a first passive lead-lag network;
- a second DC amplifier for providing a wideband signal gain;
- an offset adjustment for adjusting a DC offset of an output of the first integrator network;
- 20 a second integrator network operating in conjunction with the first integrator network to provide performance of a two-pole integrator, wherein the second integrator network is a second passive lead-lag network;
- an output amplifier for amplifying an output of the second integrator network; and
- 25 a matching combiner for matching a characteristic impedance of the first unbalanced RF coaxial transmission line.

19. The system as set forth in claim 16, wherein the first unbalanced RF coaxial transmission line is impedance matched at the unmodulated flux locked loop and
30 is not impedance matched at the superconducting quantum interface device.

20. The system as set forth in claim 16, wherein the second unbalanced RF coaxial transmission line is impedance matched at the unmodulated flux locked loop and is not impedance matched at the superconducting quantum interface device.

5 21. The system as set forth in claim 16, wherein the first and second unbalanced RF coaxial transmission lines are impedance matched at both the unmodulated flux locked loop and the superconducting quantum interface device.

10

15

20

25

30